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Operating Instructions

Laboratory Planetary Mill
" pulverisette 5 "

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Operating Instructions

Laboratory Planetary Mill

" pulverisette 5 "

The "pulverisette 5" is a universal laboratory planetary mill for quick dry or wet grinding to a fineness suitable for analysis purposes. It comminutes inorganic and organic samples for analsis, qualitity control or material testing. For synthesis, it is used for mixing and homogenizing dry samples, emulsions or pastes.

The feed size for hard material should not exceed around 10 mm. The maximum feed quantity is approx. 800 ml when using 4 grinding bowls of 500 ml each and 10 grinding balls 30 mm diameter for each bowl. The fineness which can be obtained within an appropriate grinding duration is < 5µm.

Safety Instructions

* Please read operating manual before starting up
* Never cut off safety devices
* Check the safety devices regularly
* Never open machine before complete standstill
* Operating and repair only by authorized personnel
* Operating only with safety glasses
* Do not reach into machine when running
* Pull off the plug before servicing
* Disconnect the mains plug before starting work on the unit.

1. Method of Operation

The sample is pounded and ground by grinding balls in the maximun four bowls. Acting on the grinding bowl contents, consisting of material to be ground and the grinding balls, is the centrifugal force produced from the grinding bowls rotating around their own axes and the centrifugal force produced by the rotating support disk.

Since the grinding bowls and the support disc are rotating in opposite directions, the centrifugal forces act alternately in like and opposed directions. This causes the grinding balls to run down the inside wall of the bowl - the friction effect - followed by the material being ground and the grinding balls lifting off and travelling freely the inner chamber of the bowl and colliding against the opposing inside wall - the impact effect. This impact effect is intensified considerably by the grinding balls impacting with each other.

The grinding balls in pure planetary ball mills attain considerably higher impact energy than is possible with pure gravity or centrifugal ball mills. Depending on the speed set for the ball mill, this energy can amount to twenty times the earth's acceleration. This mill can therefore grind a very high quantity of material in a relatively short time.

Since the grinding bowl is sealed off by a sealing ring and a cover, materials can be ground without loss even when grinding in suspension.

2. Setting up the Planetary Mill

The planetary ball mill should be set up on a flat, stable base. It need not be secured to the base, but should be easily accessible. Its large rubber feet (9) can be adjusted in height to compensate for any unevenness.

3. Electrical Connections

3.1 Agreement of Voltage and Current

Before connecting the ball mill, the voltage and current values specified on the nameplate and the voltage that can be read on the selector switch must be checked for agreement with the values of the power supply to be used.

To adapt the equipment to the voltage of the intended power supply, which may be necessary, use the voltage selector switch.

On the reverse side of the mill, next to the built-in inlet connector for non-heating apparatus for the enclosed connection cable, there is a voltage selector switch with which an autotransformer in the equipment was set to the intended supply voltage before delivery. With this selector switch the mill can be adapted to a supply voltage ranging from 100 to 240 volts. To do this, set the slot to the corresponding number with a screw driver. (On the opposite side, however, there is no number opposite the slot - it points to the separation sign between two numbers.)

100/110/200/220/240 volts of alternating current with a protective conductor; fuse 16 amps.

> The EMERGENCY OFF button (Red Button) on the left-hand side of the unit must be pulled out.
>
> The green display, indicating readiness for operation, is illuminated when the EMERGENCY OFF button is in the pulled-out position - i.e. it is switched on.

3.2 Operating Safety

The green light indicating readiness for operation, which is located on the control desk at the front of the mill, indicates that the EMERGENCY OFF button on the left-hand side of the unit is switched on - i.e. is in the pulled-out position.

The planetary ball mill is fitted with a safety switch (22) which breaks the circuit when the lid (1) is open, thereby preventing the unit from starting up.

When the mill is switched off by means of the switch clock - i.e. either after the expiry of the preset grinding time or after the the preset continuous operation has been switched off - an electronic brake comes into effect, bringing the mill to a halt after a few seconds.

An independent safety device (4) prevents the hood from opening while the mill is still running. The hood can only be opened a short time after the drive has been switched off and has come to a halt.

The safety **EMERGENCY OFF button on the side** of the unit allows the unit to be **immediately disconnected from the power supply.** This switch should only be used to interrupt grinding in the event of an emergency - once the button has been pressed, the electronic brake no longer functions. **After the EMERGENCY OFF button has been pressed, the hood must in no case be opened until the mill has come to a complete halt.** (Caution! Danger of injury!)

> The EMERGENCY OFF button disconnects the whole unit from the power supply. For this reason, it is also used to switch off the mill for longer periods of non-operation (night-time dis-connection).

The EMERGENCY OFF button is switched on again by simply pulling out the red button.

3.3 Electrical Fuses

The equipment fuse is located on the reverse side of the housing in the built-in inlet connector for non-heating apparatus and can be reached by opening its cover.

> Spare: fine-wire fuse t 10; 5 x20

3.4 Control and Drive Motor

The ball mill is driven by a three-phase current motor, the speed of which is controlled by means of an electronic module. A frequency converter transforms single-phase 220-volt alternating voltage into three-phase 220-volt alternating current. Depending on the position of the potentiometer on the operating panel of the mill, a definite frequency is specified and at the same time the drive motor is forced to run at the corresponding speed.

The electronic control for the drive is equipped with a current monitor which switches off the drive in the very unlikely event of overload. After eliminating the fault which has blown the overload fuse, the mill must be switched off with the EMERGENCY OFF button or it must be separated from the mains, in order to neutralize the fuse. Only then can it be put back into operation.

3.5 Timer switch

A grinding time approx. 2 - 60 min. can be preset by means of a built-in timer (8).
By turning the switch anti-clockwise, continuous operation is set.

When working in continuous operation, it is necessary to check the secure attachment of the grinding bowls after approx. 3 hours of grinding.

> **Important: Sample may become heated.**

3.6 Speed Control

The speed of the ball mill can be freely selected from 0 rpm to a maximum of approx. 360 rpm using the rotary knob (7).

When the hood has been closed, the planetary mill can be switched on with the timer. The speed is determined by turning the potentiometer on the operating panel. When the potentiometer is in the 0 position (left-hand limit position) the mill does not start grinding. By turning this potentiometer clockwise, the mill is set in motion.

3 seconds after the potentiometer has been turned, the mill starts up and reaches the speed selected by setting the potentiometer.

The mill switches off as soon as the time set on the timer has expired, or must be switched off manually by returning the switch lever to the "OFF" position.

(The mill can thus be switched off at the end of the grinding process without turning the potentiometer back, and similarly the mill can be turned on again without altering the position of the potentiometer. In this way an optimum grinding speed, once established, can be retained for a subsequent grinding procedure.)

The electronic control for the drive is equipped with a current monitor which switches off the drive in the very unlikely event of overload. After opening and eliminating the fault, the mill can be reset ready for operation by switching it off and then back on again with the EMERGENCY OFF button.

The "whistling" or "singing" sound made by the drive as the mill starts up or adjusts speed is caused by the frequency converter
and the a.c. motor, and does not have any negative influence on the functioning of the mill. (When operating with inserted grinding bowls and balls, the sound is drowned by grinding noises.)

4. Choice of Grinding Bowls and Balls

When selecting the material for grinding sets, it is necessary to take into account the hardness of the sample and the permissible level of contamination caused by abrasion of the grinding parts (even when the abrasion is only slight).

For the optimum grinding result, it is necessary to determine experimentally the type (material) and size of the grinding bowls and balls, the quantity of sample to be ground and the number of grinding balls per bowl.

Grinding bowls and balls can be supplied in the following materials (information on the density is important for selecting the grinding balls):

Material (bowls and balls)	Density g/cm^3	Resistance
Agate (99.9% SiO_2)	2.6	good
Sintered corundum 1 (99.7% Al_2O_3)	3.7	good (qualified)
Sintered corundum 2 (85% Al_2O_3)	3.5	satisfactory
Zirconium oxide (97% ZrO_2)	5.7	very good
Syalon (90% silicon nitride)	3.24	very good
Polyamide bowl	1.4	adequate
Teflon balls with steel core	5.0	adequate
Chromium nickel steel, acidproof	7.8	good (qualified)
Chromium steel, hardened	7.8	good
Tungsten carbide (93% WC + 6% Co)	14.7	very good

Grinding bowls are available in various sizes and grinding balls in various diameters:

Grinding bowls (with cover and seal)	Order number		
	500 ml	250 ml	80 ml
(useful content	80-300 ml	30-150 ml	1-50 ml)
Agate	50.105.00	50.205.00	50.405.00
Sintered corundum 1	50.106.00	50.206.00	50.406.00
Sintered corundum 2	50.107.00	50.207.00	-
Zirconium oxide	50.111.00	50.211.00	50.411.00
Polyamide bowl	50.120.00	50.220.00	50.420.00
Chromium nickel steel	50.110.00	50.210.00	50.410.00
Chromium steel	50.109.00	50.209.00	50.409.00
Tungsten carbide	-	50.208.00	50.408.00

Recommended number of balls per grinding bowl (maximum):

Balls	10 mm	100	50	30
or	20 mm	20	15	5
or	30 mm	10*	6	
or	40 mm	4		

* When 4 steel bowls 500 ml each are used only 8 balls 30 mm each per bowl are recommended.

4.1 Notes for composition of Grinding Sets

Normally, grinding bowls and balls are selected from the same material since, from a qualitative viewpoint, only one contamination by possible abrasion is to be expected. If one ignores this abrasion, however, the grinding duration can be reduced by using grinding balls of very heavy materials.

For exemple hartmetal tungsten carbide balls in steel grinding bowls or zirconium oxyde balls in Syalon respectively sintered corundum bowls are suited. Of course tungsten carbide or steel bowls should never be used in ceramic or agate bowls.

After the material has been selected for the grinding set in accordance with the sample to be ground, the size and number and, possibly, the type of grinding balls is determined (refer also to point A.1 and the table on the last page of the enclosed brochure "pulverisette 5").

The size of the grinding bowl is determined by the quantity of material to be ground. The following rules must be observed when determining the size of the grinding bowl:

Rules for Filling the Grinding Bowl:

Only two thirds of the bowl volume must be filled by the grinding balls and the sample.

A third of the bowl volume must be left free for the centrifugal action to be effective.

The number and the size of the balls is determined by the type of the material to be ground. In this case, it is generally true that the larger the number of the balls the shorter the grinding time and the narrower the grain size range of the ground material.

The following recommendations are made for selecting grinding balls:

Hard samples with larger pieces of material	30 - 40 mm balls
Average piece size (2 - 5 mm)	30 mm balls
Fine materials ($\lesssim$ 0.5 mm)	20 mm balls
Homogenisation of dry or liquid samples	10 mm balls
Homogenisation of viscous samples	20 mm balls

In rare cases, it may also be beneficial to mix balls of different diameters:

If a sample consisting of large pieces of material is to be ground down to a range of few µm in a single grinding cycle, it is possible to mix e.g. 20 mm and 30 mm balls. The large balls will break down th coarse material very quickly while the small ones accelerate grinding in the fine range.

5. Start-up and Operation

5.1 Filling the Grinding Bowls

The grinding balls selected in accordance with point 4.1 are placed in the grinding bowl and only then is the material to be ground added.

Note: **Only fill up the grinding bowl to 2/3 of its volume!**
(See point 4.1)

The sealing ring and cover are fitted and the grinding bowl is inserted into the recess of the cylinder holder (17) on the cork disk.

5.2 Clamping the Grinding Set

The lock nut of the clamping set is firstly screwed back to the head of the clamping screw.

After the clamping arm has been inserted into the openings of the cylinder holder, the clamping screw is screwed down until the grinding bowl is held firmly in position. The lock nut is used to fix the clamping screw so that the latter can no longer be turned by hand.

If an 80 ml grinding bowl is used, a reducing adapter (order number 53.050.00) is fitted onto the grinding bowl before the grinding set is clamped. However, it is also possible to place two such grinding bowls one over the other.

If the quantity of the material to be ground only fills one of the grinding bowls, the unit must be balanced by clamping an empty bowl (of appropriate weight) complete with cover and sealing ring into the opposing cylinder holder (**no balls in empty bowl!!**)

5.3 Switching on the Planetary Mill

Before closing the lid (1) of the ball mill, a further check should be made that the grinding sets and clamping sets are fitted securly. Then close the lid and secure it with the two closures.

Turning the rotary knob (7) counter-clockwise sets the speed to 0. After switching on the unit with the timer (8), the rotary knob (7) can be turned to gradually increase the number of revolutions and to set the desired rotational speed.

Good and rapid grinding is obtained when the balls can be clearly heard to be knocking in the grinding bowls.

When working in continuous operation, it is necessary to check the secure attachment of the grinding bowls after approx. 3 hours of grinding.

5.4 Grinding Fineness

The fineness of the ground material depends, first and foremost on the **grinding time.** The fineness is also influenced by the rotational speed - i.e. the set speed of the ball mill, the **number and size of balls,** their mass (i.e. their material type) and **the size of the grinding bowls.**

With dry grinding the fineness which can be obtained is generally about 20 µm and with wet grinding < 5 µm.

Grinding Time:

The grinding time required depends of the material. A long grinding time increases the fineness of the particles.

Speed:

The fineness of the particles increases the higher the speed.

Size of the Grinding Balls:

Coarse, hard material is broken down more quickly using large balls, although the degree of grinding fineness obtained after a standard grinding period will be considerably coarser. Using a large number of small balls enables optimal grinding fineness to be achieved, but in the case of coarse, hard material requires an excessively long grinding time. These types of coarse, hard samples should first be pre-ground with large balls, and then ground to the required degree of fineness with smaller balls in a second grinding process.

Mass of the Grinding Bowls:

The grinding process is accelerated by using grinding balls of higher mass (specific weight).

Size of Grinding Balls:

The centrifugal force acting on the grinding balls in relativly large grinding bowls is correspondingly higher and the grinding performance is increased for identical grinding time.

Important: Agglomeration of material when dry grinding.

When a certain degree of fineness is achieved there is an increased tendency towards agglomeration. Depending on the characteristics of the material to be ground, this effect can be of decisive importance even with grain sizes of less than 10 microns. Due to the increasing surface forces, the individual particles begin to stick to one another, the grinding balls and to the sides of the grinding bowl. The agglomeration and layers that have been formed are thus not subject to any further comminution.

Only through so-called wet grinding - that is grinding where the material to be ground is slurried in liquid suspension - can comminution of the material be continued further. To stabilize the grain size obtained - i.e. to reduce the formation of agglomerated material during or after grinding - a tenside can also be added to the suspension liquid. There is, however, no rule that generally applies for selecting a tenside, since tensides have to be adapted to the characteristics of the material to be ground.

6. Maintenance

Important: Disconnect the mains plug before beginning maintenance work.

The planetary ball mill requires no special maintenance.
Bearings of the rotating parts have permanent lubrication. The V-belts may need to be retightened after long periods of operation (see point A 2.1 - 2.13)

6.1 Cleaning

The most important element of the maintenance work is that the parts be cleaned regularly. The grinding bowls and balls should be cleaned after every grinding cycle. This can be done by brushing off the grinding parts e.g. under running water using commercially available detergents. Cleaning is also possible in ultrasonic baths. The grinding parts can be heated up to around 250°C in a drying cabinet if sterilisation is required. However, grinding parts of agate may not be heated to over 110°C and must then be cooled down slowly.

6.2 Drive Motor

The drive motor is a three-phase a.c. motor, and requires no maintenance.

If for any reason, the drive motor or its electronic control needs to be exchanged, the control and motor should be realigned to each other before starting up the ball mill (refer to Annex A.3 for conversion instructions.)

7. Guarantee

The guarantee card accompanying delivery of this unit must be completed and returned to the manufacturer to be valid.

FRITSCH GmbH, Idar Oberstein, and its Application Laboratory
or its respective agency abroad will be pleased to provide further information and advice on request.

Any enquiry should be accompanied by details of the serial number given on the nameplate.

Annex

A.1 Examples

The following examples from the Application Laboratory of FRITSCH GmbH provide information on the choice of grinding sets, the optimum grinding time and fineness which have been achieved for various ginding samples:

Material Quantity Edge length	Grinding bowl Material Volume	Grinding balls Material No x dia.	Grinding time	Fineness
Ruby (stone)				
140 g 12 mm	Cr-Ni-steel 250	Cr-Ni-steel 6 x 30	3 min	100% <250 µm
Titanium dioxide TiO_2 (dry and wet grinding in water)				
40 g 2 mm	Cr-Ni-steel 250	Cr-Ni-steel 6 x 30	30 min	100% < 40 µm
Titanium dioxide TiO_2 (dry and wet grinding in water)				
40g/50 ml 2 mm	Cr-Ni-steel 250	Cr-Ni-steel 6 x 30	60 min	100% < 10 µm
Coal (dry and wet grinding in water)				
5 g 0.5 mm	Zirconium oxide 80	5 x 20	120 min	100% < 15 µm
Coal (dry and wet grinding in water)				
5g/5 ml 0.5 mm	Zirconium oxide 80	5 x 20	120 min	100% < 15 µm
Aluminium oxide/Silicon dioxide				
100 g 0.1 mm	WC + Co 250	WC + Co 15 x 20	90 min	90% < 20 µm
Ferrovanadium				
70 g 3 mm	WC + Co 250	WC + Co 5 x 30	20 min	70% <100 µm
Glass				
50 g 4 mm	Agate 250	Agate 15 x 20	15 min	100% < 90 µm
Silicon carbide (dry and wet grinding in water)				
15 g 3 mm	WC + Co 80	WC + Co 5 x 20	30 min	100% <150 µm
Silicon carbide (dry and wet grinding in water)				
15g/5 ml 3 mm	WC + Co 80	WC + Co 5 x 20	45 min	100% < 71 µm
Rock phosphate				
40 g 3 mm	Cr-steel 250	Cr-steel 15 x 20	2 min	100% <250 µm

Material Quantity Edge length	Grinding bowl Material Volume	Grinding balls Material No x dia.	Grinding time	Fineness
Manganese oxide MnO_2 (dry and wet grinding in water)				
50g/40 ml 0.1 mm	WC + Co 250	WC + Co 15 x 20	60 min	100% < 20 µm
Sewage sludge				
180 g 8 mm	Al_2O_3 500	Al_2O_3 10 x 30	30 min	100% <250 µm
Active charcoal (wet grinding in water)				
150 ml 0.025 mm	Cr-Ni-steel 250	Cr-Ni-steel 15 x 20	30 min	100% < 5 µm
Gypsum				
300 g 10 mm	Cr-steel 500	Cr-steel 10 x 30	20 min	100% <200 µm
Albumen				
50 g 20 mm	sintered cor.1 250	sintered cor.1 6 x 30	90 min	90% < 50 µm
Corn (barley)				
100 g 3 mm	sintered cor.1 500	sintered cor.1 3 x 40	20 min	100% <150 µm
Noodles				
100 g 5 mm	sintered cor.1 500	sintered cor.1 10 x 30	3 min	100% <250 µm
Sugar (wet grinding in alcohol)				
200 g 1 mm	agate 500	agate 10 x 30	45 min	100% < 10 µm
Sausage (meat goods; wet grinding in water)				
100 g 5 mm	sintered cor.1 500	sintered cor.1 10 x 30	30 min	homogen.
Artemia salina embryos				
4 g 2 mm	zirconium oxide 80	5 x 20	20 min	100% < 50 µm
Grass (dried as hay)				
35 g 50 mm	sintered cor.1 500	sintered cor.1 10 x 30	7 min	100% <500 µm

A.2 Instructions for Upgrading to Four Grinding Bowl Holders

Caution: Work on electrical equipment may only be performed by an expert

The "pulverisette 5/2" with 2 grinding stations can be upgraded to a planetary ball mill with four grinding stations. For this purpose, the conversion kit (order number 05.220.00) is assembled in accordance with the following instructions. (These instructions also apply in a similar manner for changing the bearing of the plate supports (16) in the event of wear.)

1. Open the unit and remove the cork discs in the clamping device (17).

2. Remove the hexagon socket screws using a 6 mm box spanner and remove the holder.

3. Remove 4 screw covers, unscrew the screws with a size 13 fork spanner, lift off the cover plate and the 4 spacer bolts.

4. Stand the unit upside down on a soft base.

5. Remove the five securing screws from the base plate.

6. Disconnect the motor (detach Phoenix terminals 1,2,3 and 4 on the electronic control).

7. Lift out the base plate and put it to one side.

8. Use a 30 mm fork spanner to undo the securing nut of the two plate shafts (use 13 mm fork spanner to hold the square bolt).

9. Remove the V-belt.

10. Insert the plate shafts required for the conversion into the 30 mm bores and tighten slightly with a size 30 nut.

11. Fit two V-belts (10 x 670) so that, in each case, a V-belt is fitted around two neighbouring pulleys and fixed pulley in the centre.

12. Turn the eccentric of the four plate shafts in the same direction using a size 13 fork spanner.

13. Use a suitable measuring tool (e.g. slide gauge or depth gauge) to measure the distance of the plate shafts from the outer edge of the support disc and adjust the plate shafts so that this dimension is the same for all and the V-belts are taut at the same time (dimension approx. 23 mm $\pm$ 0.1 mm). A similar procedure is adopted if the V-belt of the plate supports have to be tensioned.

14. Use a size 13 fork spanner to hold the eccentric firmly and tighten the securing nut using a size 30 fork spanner. (The fork spanner extension may need to be used.)

15. Then remeasure the distance from the plate shaft to the outer diameter of the support disc and correct the adjustment if necessary.

16. Insert the base plate into the housing (important: remember to reinsert the rubber discs (8 x 20 x 2.5) between the base plate and the housing!).

17. Insert five securing screws into the base plate and tighten securely.

18. Connect the motor (attach Phoenix terminals 1, 2, 3 and 4 to the electronic control. Protective conductor located in terminal 1.)

19. Turn the unit the right way up.

20. Insert four spacer bolts, fit the cover plate, screw it on with hexagon socket screws, and fit screw covering.

21. Switch on the unit and check the concentricity of the cover disc; if necessary, readjust it by shifting the cover disc appropriately.

22. Fit 4 bowl holders and screw on with hexagon socket screws; insert cork discs.

23. Switch on the unit for a trial run and check for unbalance (slight, uncritical unbalance may be caused by bowl holders).

A 3. Exchanging the Drive Motor and Electronic Control.

A 3.1 Exchanging the Motor

Please quote the unit number and motor type when ordering a replacement motor.

1. Open the unit and remove the cork discs in the clamping device (17).

2. Remove the hexagon socket screws using a 6 mm box spanner and remove the holder.

3. Remove 4 screw covers, unscrew the screws with a size 13 fork spanner, lift off the cover plate and the 4 spacer bolts.

4. Stand the unit upside down on a soft base.

5. Remove the five securing screws from the base plate.

6. Disconnect the motor (detach Phoenix terminals 1,2,3 and 4 on the electronic control).

7. Lift out the base plate and put it to one side.

8. Unscrew the securing screws inside the motor console (4 x M6 hexagon socket screw No. 5) and, after removing the V-belt, lift out the motor.

Before the belt pulley on the motor shaft is removed, the distance to the screw flange of the motor must be measured. The pulley must be refitted on the replacement motor at the same distance since only then can the V-belt run correctly.

The replacement motor is fitted in the reverse sequence of steps.

<u>The plug and the connections of the control pcb must be reconnected in the same way.</u>

A 3.2 Exchanging the Electronic Control

Please quote the unit number when ordering replacement parts.

1. Open the unit and remove the cork discs in the clamping device (17).

2. Remove the hexagon socket screws using a 6 mm box spanner and remove the holder.

3. Remove 4 screw covers, unscrew the screws with a size 13 fork spanner, lift off the cover plate and the 4 spacer bolts.

4. Stand the unit upside down on a soft base.

5. Remove the five securing screws from the base plate.

6. Disconnect the motor (detach Phoenix terminals 1,2,3 and 4 on the electronic control).

7. Lift out the base plate and put it to one side.

8. Detach both plug terminals from the frequency converter.

9. Unscrew the securing screws in the exposed fastening rail and remove the rail.

10. The whole frequency converter is then lifted out of its lower holding rail and placed to one side.

Reverse these steps to install a replacement converter. **The two connection plugs to the frequency converter must be connected exactly as before.**

A. 3.3 Alignment of the Motor Control

The electrical equipment is aligned to the planetary mill drive motor before replacement frequency converters are dispatched. It is not necessary to carry out an alignment in the unit after the electronics have been replaced. The setting potentiometers on the electronics must not be altered.

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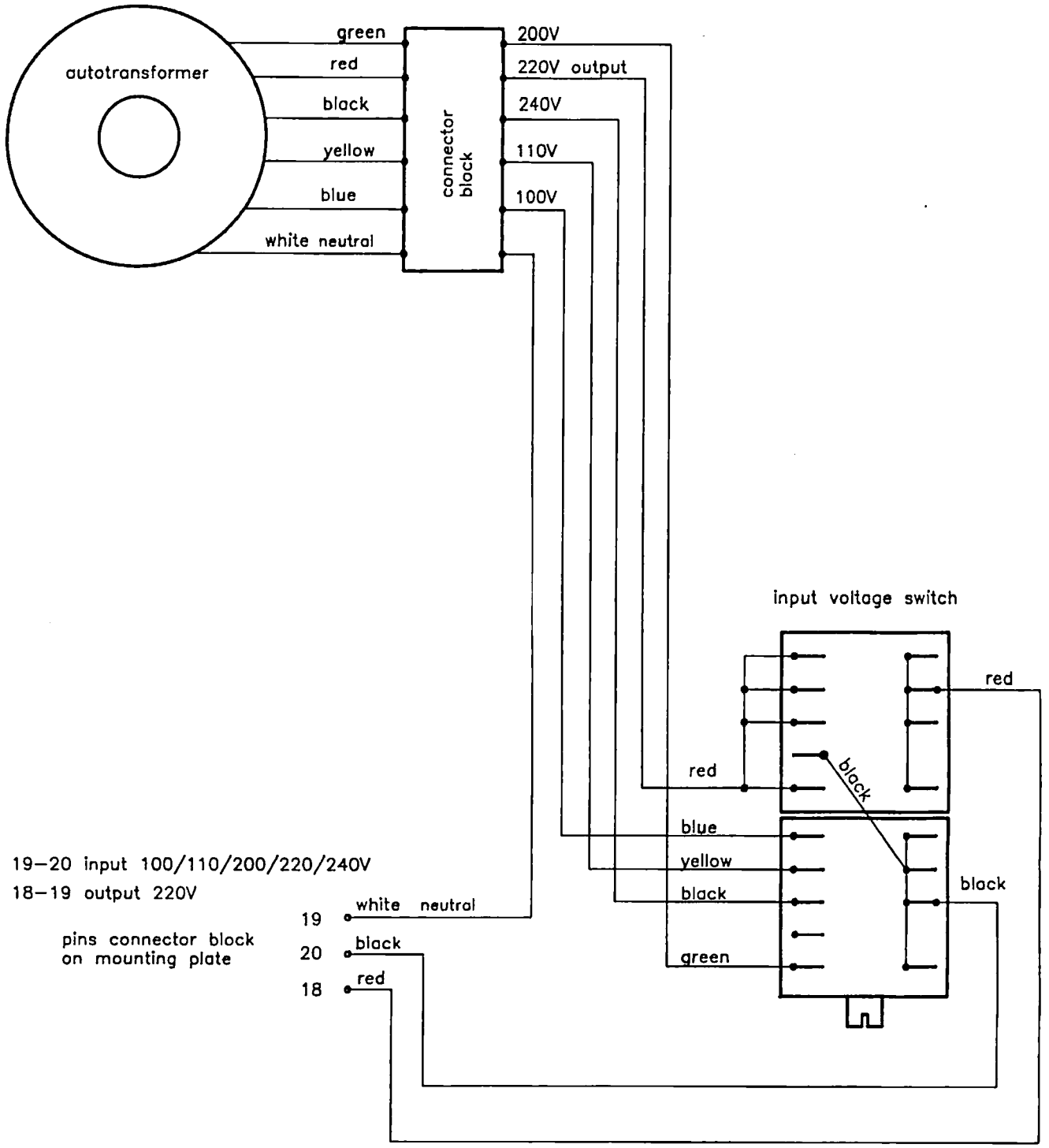
Ersatzteil-Liste Labor-Planeten-Mühle P5/4 und P5/2 30.10.92

Spare parts list Laboratory Planetery Mill P5/4 and P5/2

Nr.	Artikelnr.	Bezeichnung	Description
1	05.112.13	Haube	lid, alu-cast
2	93.910.00	Verdeckverschluß	lever close
3	92.608.13	Griff	handle
5	86.417.00	Signalleuchte grün	signal lamp
	86.422.00	Glimmlampe 220V	low voltage neon-glow lamp
	86.416.00	LED-Anzeige 3,5 stellig	LED display
	05.160.13	Frontplatte	front panel
6	81.403.00	Knebelknopf D=40	spindle shaped button D=40
7	81.405.00	Drehknopf D=23	turning knob D=23
8	81.479.00	Zeitschalter	timer
9	93.405.00	Gerätefuß M10x27,D=50	instrument foot,D=50
10	82.504.00	Kugellager 6005Z DIN 625	ball bearing 6005Z DIN 625
11	82.603.00	Nadellager NKI 20/20	neddle bearing NKI 20/20
12	82.513.00	Kugellager 6008RS	ballbearing 6008RS
13	82.511.00	Kugellager 6010Z	ball bearing 6010Z
14	82.011.00	Keilriemen 10x670li 4 Becher	v-belt 10x670 4 bowles
	82.012.00	Keilreimen 10x560li 2 Becher	v-belt 10x560 2 bowles
15	05.114.12	Trägerscheibe	support disc, grey-cast
16	05.119.09	Tellerträger, ST 1191	bowl plate support steel
17	90.047.00	Spannsatz, P5 Topfhalterung	gripping power(pot-holder)
18	82.010.00	Keilriemen 13x8x1346	v-belt13x8x1346
19	81.265.00	Motor P5	motor P5
20	81.380.00	Frequenzumrichter SLP 550-1	frequency inverter SLP 550-1
	86.520.00	Motorschutz	relay
	81.407.00	Motorschutzrelais 2,4-4A	motor overlaod relay 2,4-4A
	81.100.00	Platine Überlastschutz P5	overload protection lifter P5
21	93.402.00	Schwingpuffer M6x15	leaf screw M6x15
22	81.460.00	Mikroschalter	micro-switch
23	92.919.00	Deckelschanier	lid-hinge
24	92.166.09	Blattschraube M6x15	leaf-screw M6x15
25	05.145.00	Gasfeder P5	pneumatic spring holder
26	81.465.00	Mikroschalter für Haubenverriegelung	micro switch for interlocking magnet
27	86.850.00	Ringkerntrafo 220V/1,1kW	transformer 220V/1,1kW



Lfd. Nr.	Stck.-zahl	Benennung	Sach-Nr.	Bemerkung

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Freimasstoleranzen nach DIN 7168
☐ fein
☒ mittel
☐ grob

Teil Nr.

	Tag	Name
Bearb.	28.10.92	Baer
Gepr.		
Norm		

Werkstoff

Ausgabe	Aenderung	Tag	Name

FRITSCH GMBH
D 6580 IDAR-OBERSTEIN

FRITSCH
pulverisette
analysette
laborette

Benennung: wiring transformer and input voltage switch

Mass-Stab: 1:1

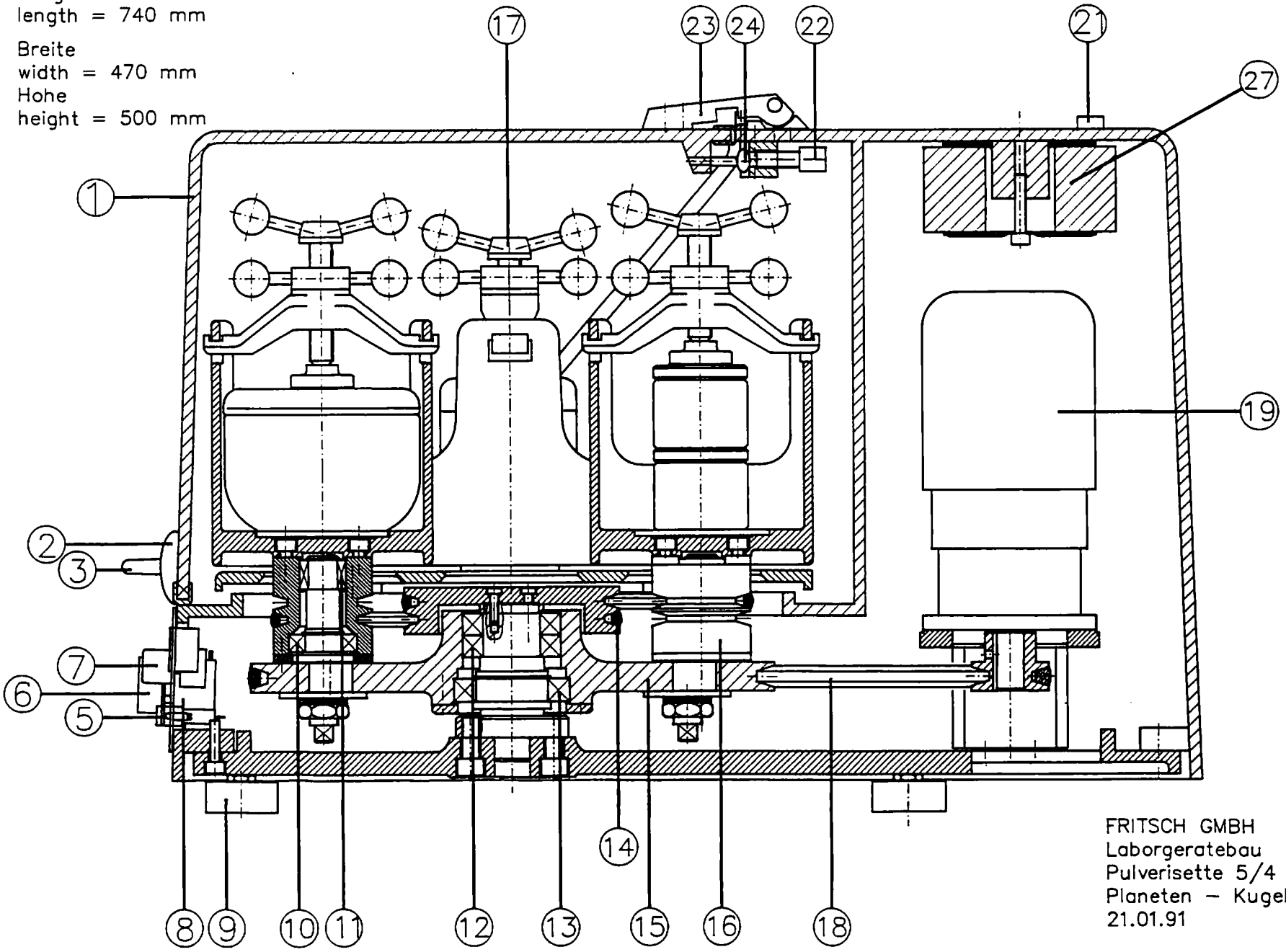
Zeichn.-Nr.

Typ

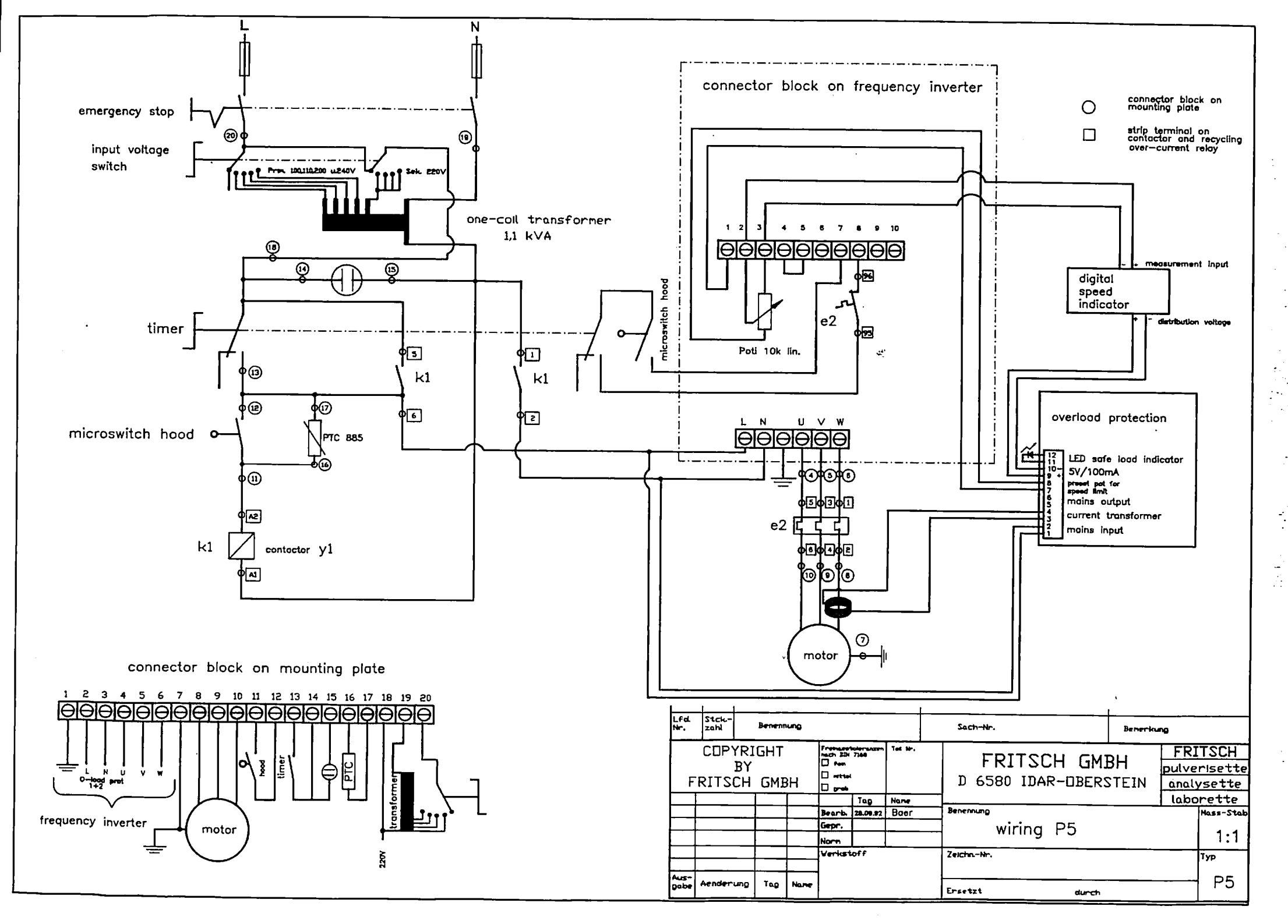
Ersetzt durch

Lange
length = 740 mm

Breite
width = 470 mm
Hohe
height = 500 mm



FRITSCH GMBH
Laborgeratebau
Pulverisette 5/4
Planeten – Kugelmuhle
21.01.91



Lfd. Nr.	Stck.-zahl	Benennung	Sach-Nr.	Bemerkung

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Freimaßtoleranzen nach DIN 7168
☐ fein ☐ mittel ☐ grob

Tol Nr.

	Tag	Name
Bearb.	28.09.92	Baer
Gepr.		
Norm		
Werkstoff		

Ausgabe	Aenderung	Tag	Name

FRITSCH GMBH
D 6580 IDAR-OBERSTEIN

FRITSCH
pulverisette
analysette
laborette

Benennung
wiring P5

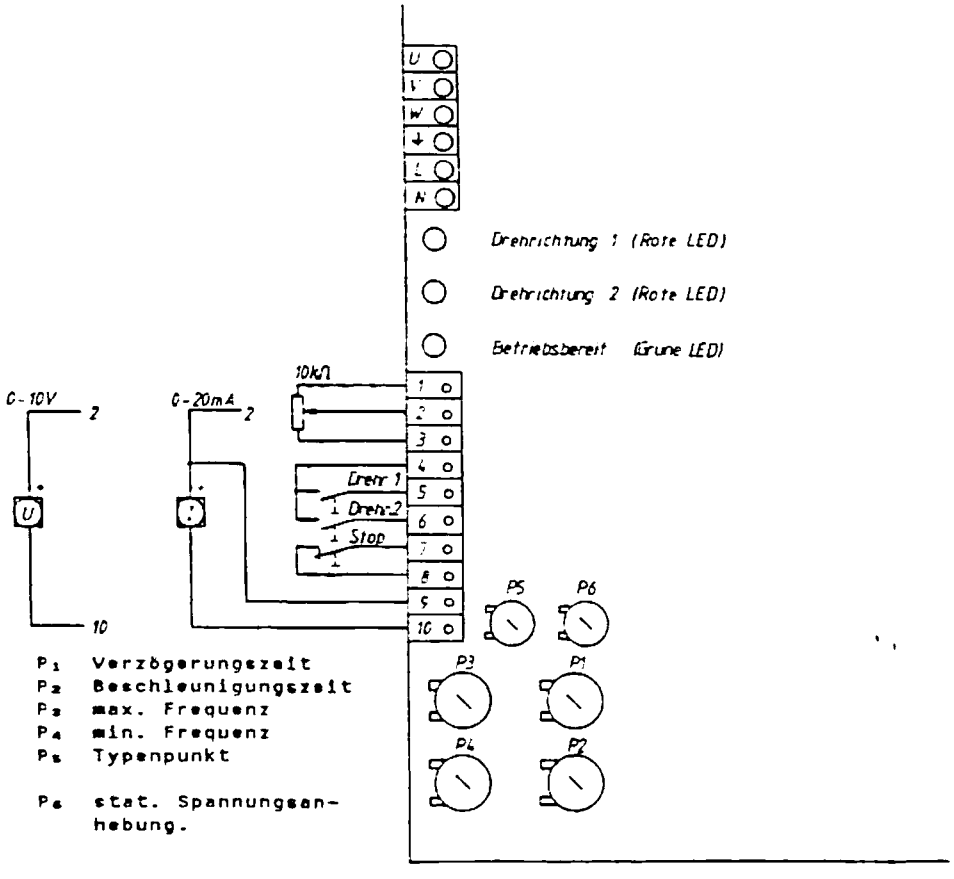
Maß-Stab
1:1

Zeichn.-Nr.

Typ
P5

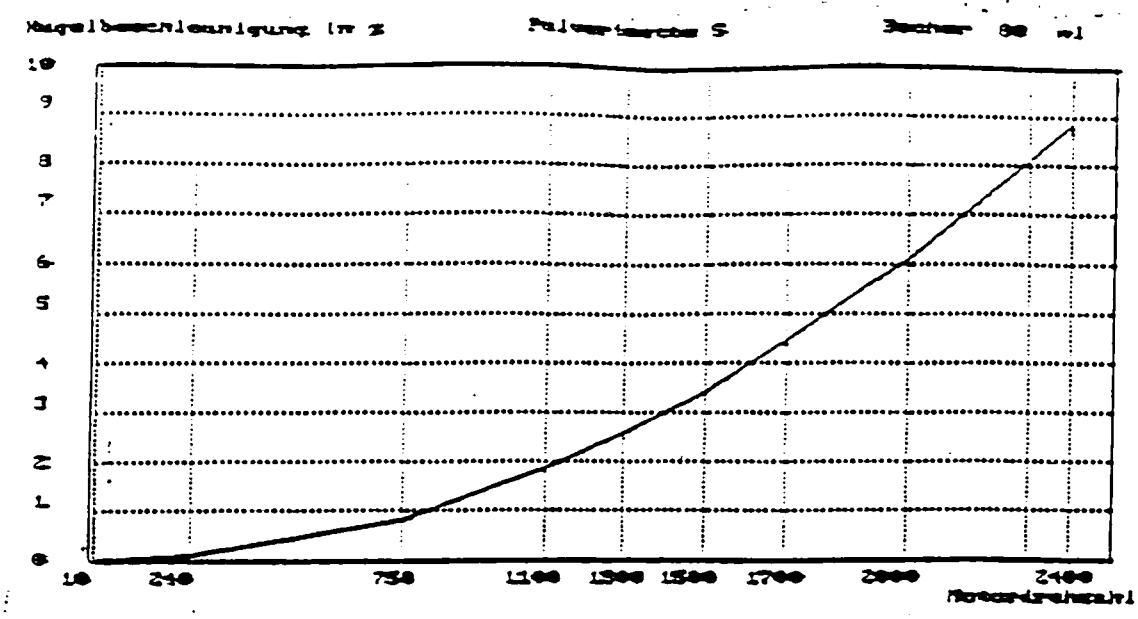
Ersetzt durch

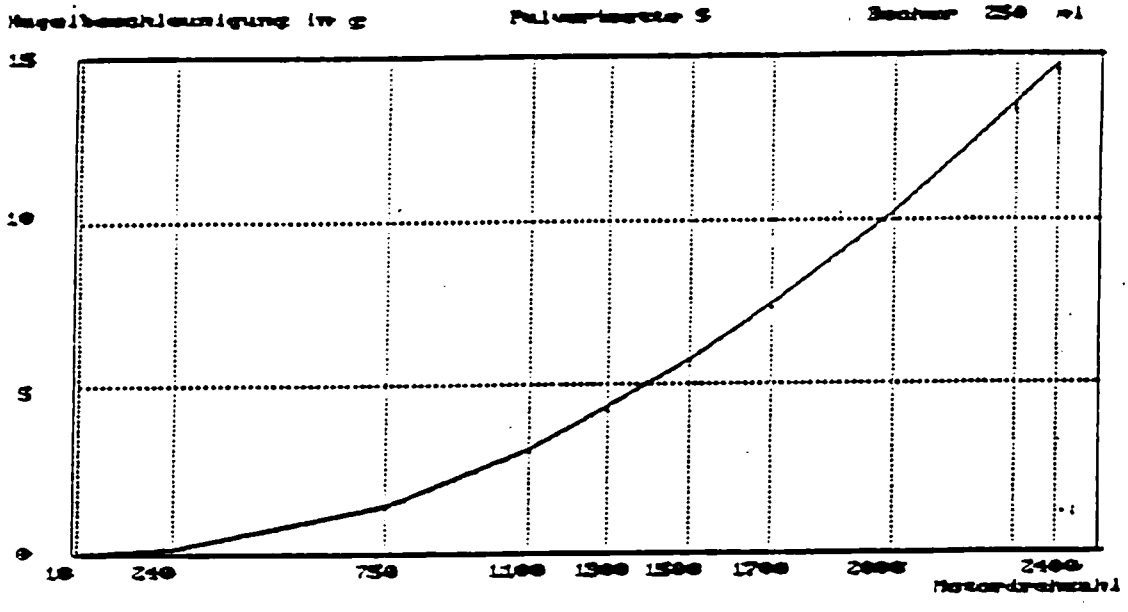
2.3 Übersicht der Steueranschlüsse

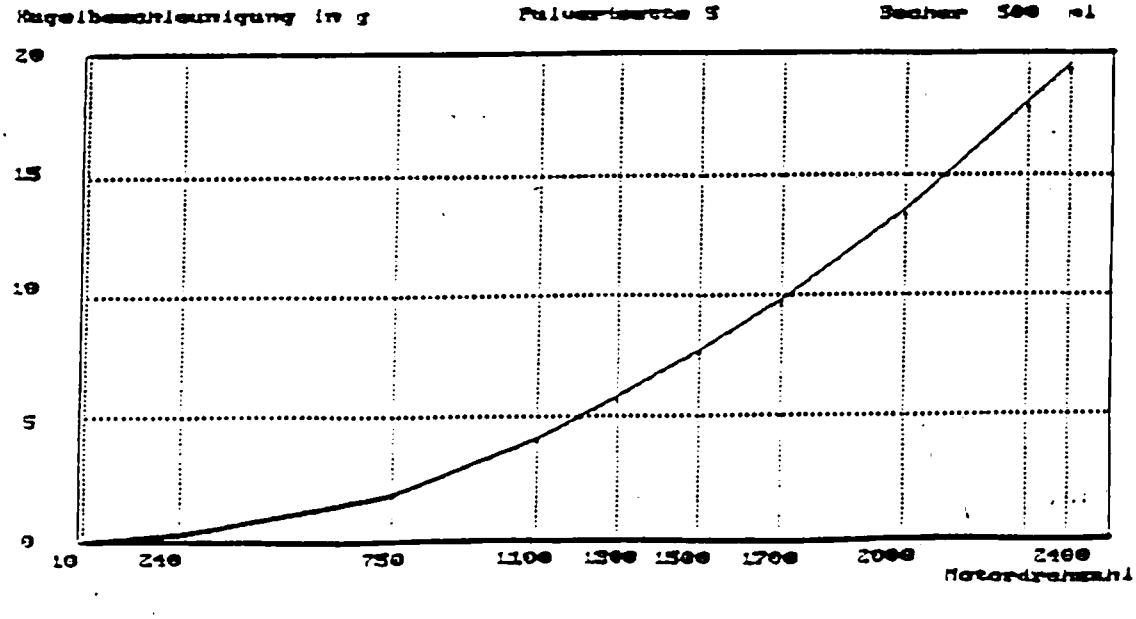


P_1 Verzögerungszeit
P_2 Beschleunigungszeit
P_3 max. Frequenz
P_4 min. Frequenz
P_5 Typenpunkt

P_6 stat. Spannungsanhebung.


10
9
8
7
6
5
4
3
2
1
0
240
750
2400


15
10
5
0
240
750
2400


20
15
10
5
0
240
750
2400